

# **GEOLOGIC MAPPING OF MTM QUADS 40292 AND 40297: IN THE UTOPIAN LOWLANDS NORTH OF THE NILOSRTIS MENSAE, MARS.**

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**Introduction.** Geologic mapping at 1:500,000 scale of the MTM quads 40292 and 40297 is being conducted under the auspices of the Mars Geologic Mapping Program. The study area is located in the southwestern portion of Utopia Planitia immediately north of the Nilosyrts Mensae, between latitudes 37.5 and 42.5° and longitudes 290 and 300°. The goals of the mapping are to identify the major geologic features in the study area and to determine the sequence and scope of the geologic events that have modified the lowland side of the global dichotomy boundary in this region in order to at least partially constrain models of dichotomy boundary origin and evolution; this is a progress report.

**Regional Geology.** The study area has been mapped previously at a much larger scale by three previous investigations. The first (1,2) were the maps based on surface morphology based on Mariner 9 images. Viking images were used to derive a global view of martian geology (3) in which the study area was mapped to have Hesperian-age plains units to the north, Hesperian-age knobby material, and Amazonian-age cratered plains. Later mapping (4) grouped the older units of (3) together and identified the plains units in the map area as Amazonian-age smooth and etched plains. The plains units to the north of the study area are Hesperian in age and the plateau units south of the study area are Noachian in age and overlie older heavily cratered terrain (4).

The dichotomy boundary lies immediately south of the study area (Figure 1). It appears that the boundary predates the emplacement of the Hesperian-age plains for the following reasons. As one looks further to the south of the study area, there is a rather abrupt southern margin of the plains unit, then a region of valleys, many with lineated valley fill, where the elevation appears lower than the plains. Farther south is an irregular escarpment formed by Noachian-age plateau units of the highlands. It is very likely that the plateau units once extended farther north and that the plains were emplaced against them. Subsequent differential erosion has caused the retreat of the escarpment as much as a hundred kilometers or more. If that is true, then the southern edge of the plains units marks the dichotomy boundary at the time of the emplacement of the plains.

**Local Geology.** The most obvious feature of the map area at first glance is the abundance of small knobs (Figure 2), termed the Colles Nili, or "Hills of the Nile Region" (after 5). Three possibilities of their origin have been recognized (2): a) they are bits of older terrain that protrude through younger terrain, b) they are erosional remnants of plateau materials with the edge of the plateau (highland side of the dichotomy boundary) now being farther south, or c) they are igneous intrusives exposed by differential erosion.

Another prominent local feature is the presence of a complex veneer of material that is prevalent throughout the study area (Figure 3). Its thickness varies widely from location to location, and the subunits of which it is composed appear to have little lateral continuity. In some locations, the knobs appear to be smoothly mantled by the veneer deposits, in others, the knobs clearly protrude through the plains units around them. The veneer is probably very young because there is not a single unequivocal example in the entire study area of an impact crater that was emplaced atop the veneer. Accurate mapping is rendered difficult by the presence of the veneer and the lack of medium to high-resolution photography for parts of the study area.

Most of the study area is covered by a plains unit. It is probably a flood basalt deposit because it contains a number of lunar mare-type wrinkle ridges. Its age is almost certainly Upper Hesperian, for the following reasons. Crater counting in the study area

gives an N(2) crater count of ~500 (corresponds to late Upper Hesperian (6)) and an N(1) crater count of ~1200 (corresponding to middle Lower Amazonian (6)). No doubt many of the 1 km craters were not counted because they were rendered unrecognizable by the younger veneer, hence, the N(2) age should be considered more reliable. The study area is too small and there are an insufficient number of larger craters to derive similar crater ages based on craters larger than 2 km. Another important factor in determining the age of the plains unit is that it contains a number of secondary clusters whose orientation suggest that they are from the Lyot impact over 1000 km to the northeast. If that is true, then the plains cannot be younger than Lyot, which was formed in early Amazonian time (6).

The veneer materials are of limited lateral continuity and vary in thickness throughout the study area. In a very few places, eroded remnants of channels mark their surface. It is likely that the veneer represents some sort of volatile-rich airfall-type deposit or deposits. It may be that the veneer represents many different, yet all recent, episodes of deposition and erosion. That would account for the varying thickness and poor lateral continuity of the deposits. Further evidence that the veneer is the result of multiple depositional and erosional events comes from the presence in the study area of many craters with concentric crater fill (Figure 4), which probably results from repeated deposition and erosion (7).

#### References.

1. Lucchitta, B.K., 1978, Geologic map of the Ismenius quadrangle of Mars, USGS Map I-1065.
2. Greeley, R., 1978, Geologic map of the Casius quadrangle of Mars, USGS Map I-1038.
3. Scott, D.H. and M.H. Carr, 1978, Geologic map of Mars, USGS Map I-1083.
4. Greeley, R. and J.E. Guest, 1987, Geologic map of the eastern equatorial region of Mars, USGS Map I-1802-B.
5. Blunck, J., 1977, *Mars and its Satellite: A Detailed Commentary on the Nomenclature*, Hicksville: Exposition Press, 200 p.
6. Tanaka, K.L., 1986, The stratigraphy of Mars, *Journal of Geophysical Research*, 91, B13, E139-E158.
7. Zimbelman, J.R., Clifford, S.M., and S.H. Williams, 1989, Concentric crater fill on Mars: An aeolian alternative to ice-rich mass wasting, *Proceedings 19th Lunar and Planetary Science Conference*, 397-407.

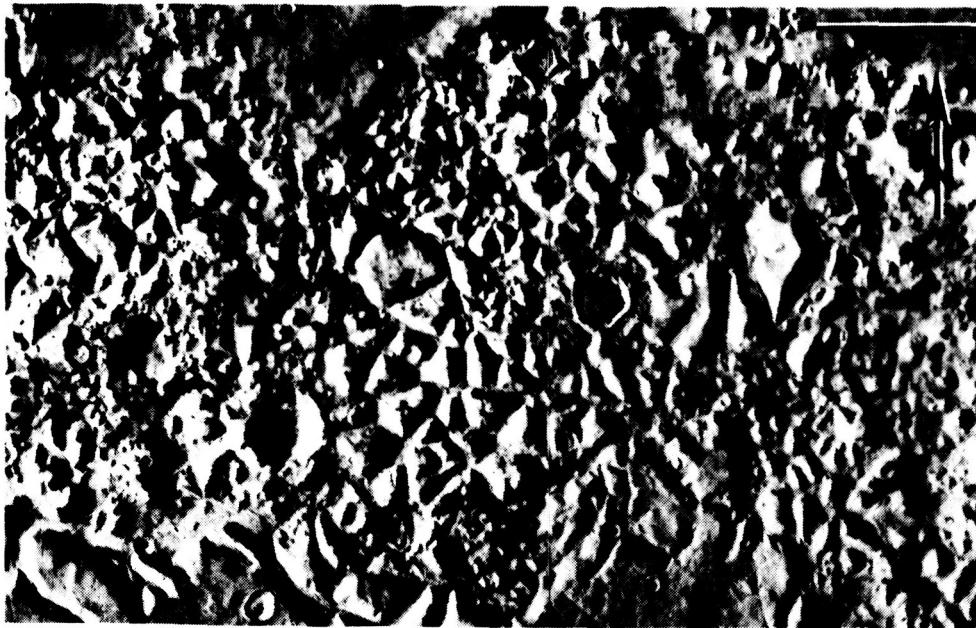


Figure 1. South of the map area, it appears that the Hesperian-age plains were emplaced against the dichotomy boundary, which has subsequently retreated by differential erosion. The edge of the plains is at the top of this image, the plateau highlands are at the bottom. The scale bar is 50 km long; these are portions of Viking frames 534A01 and 03, NGF version, orthographic projection.

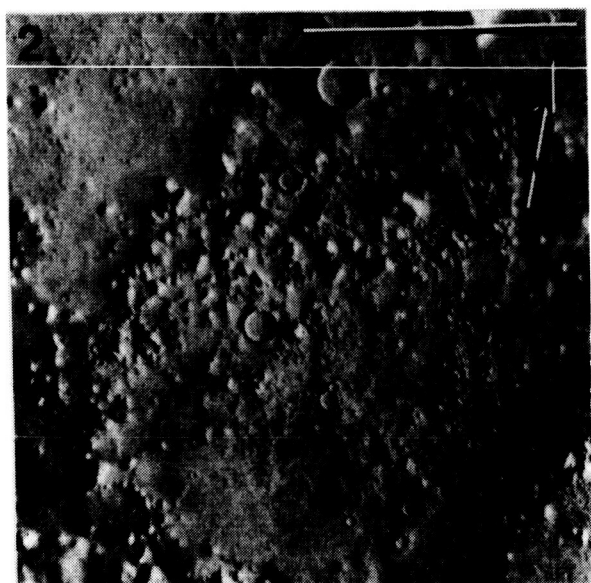


Figure 2. Knobby terrain is prevalent throughout the study area. The knobs appear to be remnants of ancient, heavily-cratered terrain that underlies both the Hesperian-age plains and the plateau units to the south. The scale bar is 100 km long; this is a portion of Viking frame 801A34, NGF version, orthographic projection.

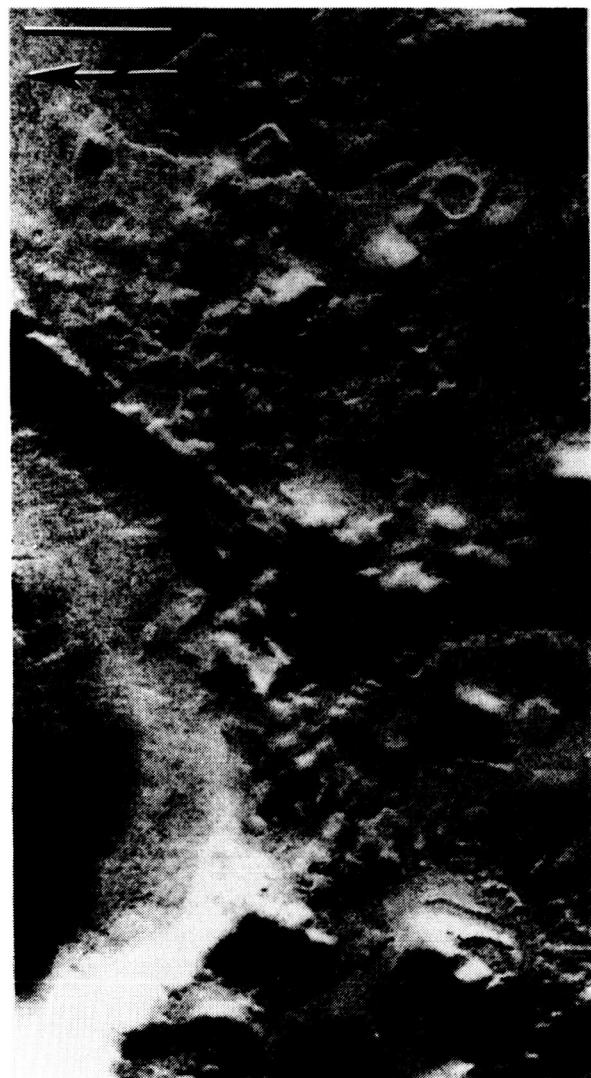


Figure 3. The veneer deposits are thickest just south of the crater Renaudot in quad 40297. Some small channel segments are visible in the veneer and several knobs appear to have eroded remnants of where the veneer once ramped up against them more completely than at present. The scale bar is 10 km long; this is a portion of Viking frame 234S74, NGF version, orthographic projection.

Figure 4. Craters with concentric crater fill may indicate repeated episodes of relatively recent deposition and erosion (7). The volume of the fill in the crater marked by an arrow is too great for the fill to have come entirely from the crater rim. The scale bar is 20 km long; this is a portion of Viking frame 11B44, SCR2 version, rectilinear projection.

